1. Raising the temperature of a reaction will generally do what? (5 points)
   A) make it go faster    B) make it go slower    C) nothing
   D) increase the reaction energy    E) reduce the activation energy

2. Which of the following is a Brønsted acid? (5 points)
   A) CH₄      B) CH₃CH₂OH      C) NaOH      D) H₃PO₄      E) CH₃COCH₃

3. How many grams of ¹⁰Li are left if a 16.0 gram sample of ¹⁰Li is allowed to decay for a period of 3.00 half-lives? (5 points)
   A) 16.0 g   B) 8.00 g   C) 5.33 g   D) 4.00 g   E) 2.00 g

4. What is the H–C–H bond angle in a CH₄ molecule? (5 points)
   A) 90˚      B) 180˚      C) 109˚      D) 120˚      E) 45˚

5. Benzene (C₆H₆) is an example of what kind of molecule? (5 points)
   A) alkane    B) alkyne    C) alcohol    D) aromatic    E) square

6. What atom type is present in thiols that is not present in other functional groups? (5 points)
   A) N      B) S      C) H      D) O      E) C

7. What is the atomic mass number for an atom which has 16 protons, 17 neutrons and 18 electrons? (5 points)
   A) 16      B) 34      C) 35      D) 36      E) 51

8. What is the pH of the following solutions (Kᵢₙ = 10⁻¹⁴)? (6 points)
   1.0x10⁻⁴ M HCl
   5.0x10⁻² M H₂SO₄
   1.0x10⁻³ M NaOH
9. Draw two different isomers that are alcohols and have the formula \( \text{C}_{10}\text{H}_{11}\text{OH} \) (5 points each):

10. Give the formulas for the following compounds: (5 points each):

   - nitric acid
   - potassium hydroxide

11. Balance each of the following nuclear reactions: (5 points each)

   - \( ^{235}\text{U} \rightarrow ^{4}\text{He} + \_ \_ \_ \) (this is an “alpha” decay)

   - \( ^{14}\text{C} \rightarrow ^{0}\text{e} + \_ \_ \_ \) (this is positron emission or “beta” decay)

   - \( ^{127}\text{I} + ^{0}\text{n} \rightarrow \_ \_ \_ \) (this is neutron capture)

12. Using the diagram below, explain what would change if a catalyst for the reaction were present and how this would affect the rate of reaction. (15 points)
13. Describe in your own words at least one use of nuclear chemistry/reactions in use today. (9 points)

14. Identify all of the functional groups on the following two molecules. (14 points)

15. What is the product in the following two reactions when both are heated in the presence of an appropriate catalyst? (6 points)

\[
\text{CH}_3\text{CH}_2\text{CH}═\text{CHCH}_3 + \text{HCl} \rightarrow \text{CH}_3\text{OH} + \text{HOCH}_2\text{CH}_2\text{CH}_3 \rightarrow
\]